Fluoroscopic Radiation Exposure in Spine Surgery

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Disclosures

- Consultant
  - Baxano
  - Nuvasive
  - Vertera
- Stock Holder
  - SafeWire
  - VilaSpine
  - SafeRay Spine
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  - Providence
- Scientific Advisory Board
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- Travel Reimbursement
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- Research Support
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- Royalties
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The Problem

Ionizing radiation exposure during interventional medical procedures using fluoroscopy is a potential health threat to everyone near the x-ray source.
Deterministic risks (e.g., cataract, osteonecrosis)

Radiation Induced Cataract
Threshold < 500 mGy

Long-term stochastic risks (e.g., cancer)
But, What About Spine Surgery?

Radiation is Bad...

"extent of radiation exposure in patients with AIS may elevate the lifetime risk of solid cancers to between 1.4% and 2.4%.

"78% of the annual radiation exposure for operative patients occurs intraoperatively"

Prospective study measuring surgeon radiation exposure in minimally invasive transfemoral lumbocorduroi fusion

- mean fluoroscopy time of 1.69 minutes per case
- mean radiation exposure to the surgeon’s torso (under a lead apron) of 27 mrem per case.

Average to patient was 138 mGy


### Increased cancer risk among surgeons in an orthopaedic hospital

- One Ortho Hospital in Italy, 1976-2000
- Ortho – 29% risk
- Exposed (not surgeons) – 6%
- Not Exposed – 4%
- Ortho surgeons – 5X increased risk of cancer

Spinal surgeons can sustain a 10- to 12-fold increase in radiation exposure as compared with surgeons using fluoroscopy for nonspinal procedures.

But I'm Protected by Lead?

Putting in OPEN fluoroscopically assisted pedicle screws gives the surgeon 13.49 mSv of whole body occupational exposure to ionizing radiation during a typical year.

A surgeon beginning his/her career at age 30 years would exceed the lifetime limit for nonclassified workers in less than 10 years.
How Many Of You Know Your Dosimeter Readings?

In fact, how many of us wear a Dosimeter?

Results

- 59 MIS fusions were performed over 12 months
- 376 screws were placed
- Average radiation dose to the patient per screw placed was 0.50 Rem
- Average radiation dose to the surgeon per screw placed was 1.01 mRem


Surgeon radiation exposure was found to have a linear relationship with patient exposure

What About Lead?

- Above the Thyroid Shield - 13.4 mRem
- Below the Thyroid Shield - 4.31 mRem
- So, lead gives a 2/3 reduction

• Lead protects what is closer to the x-ray source, but
  the radiation that gets through is substantial
• At the waist PROTECTED by a lead apron was 27 mRem
• At the UNPROTECTED thyroid level was 32 mRem
The Solution

Use Pulse and/or Low Dose Imaging to achieve ALARA – radiation dosing
“As Low As Reasonably Achievable”
Hitting the mark with dose.

Everyone in the room, including the patient!
Radiologists, medical physicists, registered radiologist assistants, radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, “as low as reasonably achievable” (ALARA).
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Minimally invasive transfemoral lumbar interbody fusions and fluoroscopy: a low-dose protocol to minimize ionizing radiation

“Detail of the pedicle is lost with the low-dose pulsed fluoroscopy”

“For finer detail, specifically when determining the medial boundary of the pedicle on an AP view, digital spot is preferable.”
What Is LessRay?

Pulse and Low Dose degrade image quality - LessRay can improve it to close to full dose imaging
LessRay:
In clinical practice, the amount of image quality improvement achieved when a Pulsed and/or Low Dose image is processed with LessRay is dependent on the clinical task, patient size, anatomical location, and clinical practice. The dose should be set at a level to which the physician is able to achieve the adequate image quality needed for the particular clinical task. A consultation with a radiologist and a physicist may aid in determining the appropriate dose settings.
Low Dose / Low Dose
But at Pulse, 0.2 mA

Preservation of Image Quality with 92% Less Radiation Images

Spine Surgeon = Non-Classified Worker
NCRP
- Defines as (Age x 3.33mSv)
- 0.4712 mSv per Case (Some were multilevel)
If You Began Performing Kyphoplasties at age 30 and You Did Only 30 Cases/year AND NO OTHER Fluoroscopically Guided Surgeries
- Would Exceed Your Total Lifetime Limit by age 38!!

If Spinal Dsord Tech 2008;21:96-100

Cadaveric Study
- Conventional Fluoroscopy vs. LessRay
- 7 Fellowship Trained Orthopedic Spine Surgeons / Neurosurgeons
- OEC C-Arms set to 1 Pulse & Low Dose
- The Lowest Automatic Setting

Results

- In no case did any of the physicians abandon the LessRay enhanced images.
- The average duration of fluoroscopy time for the entire procedure was 65.6s vs. 11.0s (Conventional vs LessRay-Assisted, p<0.001).
- Statistically similar number of images with both methods prior to cement injection (24 vs. 21, p=0.30)
- The pulsed/low dosed procedures achieved an overall 88.8% radiation reduction over conventional imaging (36.1mGy vs. 4mGy, p<0.001).
Digitally improvement allows the physician to use the lowest radiation settings on a C-Arm. Significantly reduces the amount of radiation exposure during a radiation intensive medical procedure when compared with conventional fluoroscopy. With the aid of image enhancement software like LessRay®, a fluoroscope can provide high quality images with an order of magnitude less radiation we are currently being subjected to.

LessRay
Metal Elimination
Conclusions

Lessray:
- Improve Low Radiation Images

Low Dose Pulsed Image  lessRay® Enhanced Image